The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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The Chemical Age

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Half a Century of Progress

THERE is a popular ballad the last line of which runs "10, 20, 30, 40, 50 years ago," and this irrepressibly came to mind during Dr. Cullen's reading of his presidential address (unhappily abbreviated) to the Society of Chemical Industry. There are comparatively few chemists and chemical engineers in harness to-day who have so intimate a recollection of the state of the chemical industry 50 years ago as Dr. Cullen; but there are many who can trace during their own lifetime some of the changes that have occurred during that period. Already half a century ago were to be seen the first workings of the change that has substituted intelligence for brute strength as a means whereby men earn their living. The extract from the report of the Chief Inspector of Alkali of those days which was given by Dr. Cullen shows how the mechanisation of the process of alkali manufacture caused the "development of skill rather than of muscular powers on the part of the ordinary workman." It was noted with surprise that in one works four sets of seven carbonators were connected by pipes in which there were "no less than 204 cocks . . . yet so great has been the advance of education generally and such is the developing power of these advanced methods of manufacture that it has been found possible in the various works to select from among the ranks of the ordinary workmen those who can be trusted to control this complicated apparatus." The workmen were, moreover, able to perform simple analytical processes. Thus the industrialisation of the country paved the way for the general spread of education which has been so marked a feature of the past 20 years and which appears likely to be even more marked after the war.

One of the principal lessons, therefore, that can be learnt from a survey of the last half-century is that the need for education has not been the fad of the educationalist, but a requirement of industry whereby "man is raised from a mere toiler, valuable only in proportion mainly to his strength and muscle, to the skilled artisan where his powers of thought and judgment are brought into play as well as those of hand and arm."

Much has been written in disparagement of the industrial age, but this at least must be placed to its credit. Chemical works of 50 years ago were, in Dr. Cullen's works, "dirty and ugly." The surroundings were the same,

On Other Pages

so that the countryside in industrial areas showed great spoil heaps of slag and alkali waste, great " bings " of colliery refuse often on fire, and vegetation stunted or killed by sulphurous or tarry fumes from chemical works, beehive coke ovens, and the like. The change in 50 years has been remarkable. The beehive coke oven has virtually disappeared and the modern by-product coke oven comprises means for avoiding even the comparatively small escape of tarry gases which accompanies the charging of the ovens. The work of a succession of alkali inspectors over the period has so reduced the discharge of noxious vapours from industrial premises that the air round them is clean and almost wholesome. Medical science has investigated many of the industrial hazards to which workmen were liable—silicosis and other dust hazards in particular. Lighting and the conditions of work generally have been improved. There are works to-day which are laid out with lawns and trees so that their surroundings are almost sylvan in character. But, although a great deal has been accomplished, something yet remains to be done. Our great cities are still smoke-laden and the nation looks to the new Ministry of Fuel after the war to take the lead in smoke abolition. All technical justification for the pollution of the atmosphere by smoke has now disappeared.

Fifty years ago, and even 30 years ago, the industrial chemist with a degree was something of a rarity, and the chemist gained his knowledge by a process very similar to that of apprenticeship. The disadvantage of this method is that it tends to produce a severely practical type of mind without the theoretical background that enables unusual situations to be tackled successfully. The replacement of " practical " or hit-or-miss methods by scientific methods is another positive achievement of industrialisation.

On the debit side of the balance sheet is an increasing divergence between the heads of businesses and their staffs. Dr. Cullen records that 50 years ago the officers of the Society of Chemical Industry were, almost without exception, leaders in the industry or of ancillary activities, and most of them took an active part in the Society's affairs. Dr. Cullen remarks: " It might be pertinent to inquire why they are not playing a similar rôle to-day." The reason seems to be that industry is now concentrated in larger units and that those at the head of affairs are rarely specialists in any branch of science; often they have no more than the slightest knowledge of science. Industry requires specialists in finance, law, commerce, and the like and these, it is sad to record, have too often displaced the technical man from his rightful position.

NOTES AND COMMENTS

More About Dehydration

DEHYDRATION, it seems, is to be one of those activities which owe their development into major industries to the special needs of nations at war. We, in this country, are now using the process on a significant scale largely because of the necessity of feeding our Forces overseas with the smallest possible employment of shipping space. On the other side of the Atlantic, where the industry in many respects is still in an experimental stage, research has gone on for many years. In Canada, for instance, a Dehydration Committee was formed in 1923 by the Department of Agriculture in order to determine the best methods of dehydrating Canadian apples. The last war, of course, familiarised us with dried foods of various sorts, but the flavour was often poor and it is because this problem of preserving the original flavour has been tackled with so much success that there is a promising future for dehydration.

Behind the Scenes

IN the current bulletin of the Royal Bank of Canada an interesting survey of the industry in war time gives more than a glimpse behind the scenes of dehydration. Recent growth of the industry in the United States is demonstrated by the increase in the number of plants at work on these products. In 1940, says the bulletin, fifteen plants were producing at the rate of 5,000,000 lb. per annum. To-day there are 113 companies with an aggregate annual production of 125,000,000 lb. Products most in demand are potatoes, onions, beets, cabbages, carrots, and tomatoes. In dealing with the principle behind dehydration, the bulletin

points out that the very existence of vegetable life from year to year is, in the final analysis, dependent in one respect upon lack of moisture which inhibits the growth of bacteria and moulds. On an average, seeds, grains, and nuts contain less than ten per cent. of moisture.

Defeating the Enzyme

THE poor taste associated with some dried goods in the last war was particularly noticeable in vegetables, and research indicated that this was due to the activity of enzymes—biological catalysts which are present in all living matter, and without which the chemical changes necessary for its existence could not take place. It was discovered by pioneers in the frozen food industry that a pre-heating, or "blanching" process immediately prior to freezing prevented activity of the enzymes during the period when the food remained frozen. As a result of the lack of chemical change the flavour remained unaffected and this process also maintains the flavour in dehydrated goods. Methods of dehydration employed vary according to the product. Cut fruits such as apricots and applies are treated with sulphur dioxide, which acts as a steriliser and prevents discoloration. Vegetables and soft fruits such as raspberries or strawberries are subjected to the "blanching" process before pulping and drying over a heated drum. After testing and preliminary sterilisation, liquids, such as mik and eggs, are sprayed into a drying chamber where hot air in constant motion reduces them to a powder.

Rationalisation in Germany

CONCENTRATION and rationalisation in industry have always been a feature of the Nazi regime, the system being dictated by the tremendous call on productive capacity and labour for war purposes. This movement has been intensified during the last few months, a fact which is emphasised in the American *Foreign Commerce Weekly*, which states that Germany is, at the same time, using all available resources for the immediate production of increased amounts of war material. The paper draws the conclusion that the Germans are staking everything on victory this summer. Recent combinations of large concerns included at least one which went beyond the boundaries of Germany. This was the founding of Francolor, providing for the closer tie-up of the German chemical combine with the French dyestuff industry, as already described in THE CHEMICAL AGE. Earlier this year Metallgesellschaft and Aluminium-Werke interchanged their participation in other concerns. *Foreign Commerce Weekly* can find no cause for these combinations in the factors which led to such movements in former years. Nor can we. The Nazis have two driving policies to which they have held with an unwavering tenacity: to rob their fellow men and to enrich themselves. No doubt such a double purpose lies behind this telescoping of industry, whether conducted by Hermann Goering or any of his partners in crime.

"Ersatz" Waggons Go Show

IN war time it is relative strength that counts. The big guns of one belligerent are only large in so far as the artillery of the forces opposed to them is of a smaller calibre. This holds true throughout industry as it does on the battlefield where one side's mistakes are the other sides strength. So, when we read of Hitler's wonderful "ersatz" materials, it is just to give full credit to his chemists for their ingenuity, but only so long as we remember to regard their qualities in relation to those of the established products which they are designed to replace. It is said that the Battle of Britain was decided to some extent by the fact that the Nazi planes were mass-produced with the help of substitute materials and were therefore poorer in quality than our own. One of the Germans' major misfortunes is the diverting of the bulk of their war transport to the railways owing to the shortage of petrol. Railway maintenance had been neglected in the period of frantic preparation for war, but a high proportion of accidents from this cause is not the only problem. Substitutes have been used extensively in the manufacture of German locomotives and rolling stock. Up to a point these materials have served well in the place of metals urgently needed for other purposes. But their limitations are disclosed by markings on waggons observed by an American journalist who was in Berlin: "This waggon must not be used in trains travelling more than thirty-five miles an hour." So much for the efficiency of "ersatz."

LETTERS TO THE EDITOR

Chemical Rag Service

SIR,—We refer to the Ministry of Supply Order (S.R. and O. 1942, No. 1360) which prohibits the destruction of rags. This directly affects the multitude of firms engaged in the industry covered by your journal, who use rags for wiping and cleaning purposes, the majority of which are, at the present time, being destroyed after use. The object of our writing to you is to advise you that we have a comprehensive service which enables us to purchase or accept for credit the return of such oily and greasy rags.—Yours faithfully,

SAUL D. HARRISON & SONS.
A. H. HARRISON.

London, E.15.
July 23, 1942.

Sand-Lime Bricks

SIR,—I note in the issue of your excellent journal for July 18, on page 63, the heading "New British Standards—Metals, Refractories, Paints." The section on refractories apparently refers to the revision of B.S. 187, on sand-lime bricks. May I take this opportunity of pointing out that the sand-lime brick is usually classed as a building brick and not as a refractory material. —Yours faithfully,

A. T. GREEN.

The British Refractories Research Association, July 22, 1942.

Lamp Packing Material

SIR,—I should be greatly obliged if you would be good enough to draw the attention of your readers to the urgent need for salvaging lamp packing material for, if preserved in good condition, it can be used again, thus making a substantial saving in labour and material. All bulk or outer containers in which supplies of lamps have been delivered should be returned to the nearest depot of any member of my association, or, if there is a convenient van delivery service operated by an E.L.M.A. member they should be handed to the carman. May I point out that while the individual lamp cartons should be salvaged and passed to local salvage authorities, it is the outer containers which should be returned to the manufacturers.—Yours faithfully,

W. J. JONES, Director.

The Electric Lamp Manufacturers' Association, July 22, 1942.

Employees of 14 leading British aircraft firms have contributed nearly £25,000 in pennies to the Red Cross Penny-a-Week Fund.

New Control Orders

Fuel Information

A new Order from the Ministry of Fuel and Power extends the provisions of a previous Order requiring persons carrying on certain undertakings to keep books, accounts and records, and produce documents and information relating to such undertakings. The new Order is called "The Fuel (Records and Information) Order, 1942" (S.R. & O. 1942, No. 1388), and it revokes the previous Mines and Coal (Records and Information) Order 1942. Included in the provisions of the new Order are products of coal, petroleum or any product of petroleum, gas, electricity, wood and other "fuel" which may be specified in the future.

Mercury Metal Prices

The Ministry of Supply announces that mercury metal will be sold by them until further notice at the price of £68 10s. per bottle, ex warehouse, in the U.K., in lots of eleven bottles and over. As a result of this revision the Control of Mercury (No. 9) Order (S.R. & O. 1942, No. 1434), which came into force on July 28, has been made increasing the maximum resale prices of mercury metal. The Order provides that the maximum price for quantities of over one bottle, but less than eleven bottles, is £69 15s. per bottle, and for larger quantities £69 per bottle. There are higher prices for lots of under one bottle and for redistilled grades.

Parliamentary Topics

British Guiana Bauxite

IN the House of Commons last week Mr. David Adams asked the Under-Secretary of State for the Colonies, whether he was aware that certain bauxite deposits in British Guiana, leased to foreign prospectors, were remaining undeveloped, and whether he would take steps to see that future leases contained requisite clauses to provide for the working of concessions in the general interest. Mr. Harold Macmillan replied that it was already arranged that prospecting must commence within six months of the grant of an exclusive permission to explore for bauxite and must be continued diligently thereafter; provision was also made to secure that areas in respect of which mining leases are granted were properly worked. Moreover, the terms of the royalty arrangements were specially devised to induce rapid development.

In response to a further suggestion from Mr. Adams that six months was a protracted period, in face of the large number of unemployed, Mr. Macmillan pointed out that there were many difficulties in the rapid development of new mines, in the getting of machinery and so on.

Fuel Economy in Boiler Operation, II

Improved Automatic Control

by D. D. HOWAT, B.Sc., Ph.D., A.I.C., A.Inst.M.M.

(*Continued from* THE CHEMICAL AGE, *July 25, p. 81*)

IN another system a vertical hydraulic cylinder is rotated by a bevel wheel driven by a pinion on the stoker shaft. By casting suitable vanes or blades in the base of the cylinder a differential pressure with a downward pull will be exerted across a horizontal disc freely suspended in the oil and attached to a weigh beam. The differential pressure across the disc varies with the square of the speed of rotation of the cylinder (and with the square of the fuel feed). To balance this pressure, the other end of the weigh beam is counterweighted by a loading pressure from the master-steam controller. In this way, again, a constant fuel/air ratio is maintained while the fuel supply is varied in accordance with fluctuations in steam demand.

The power piston in the fuel auxiliary regulators actuates the control gear on the stokers. Three different methods of controlling the stokers may be adopted. The speed of the stoker motor may be varied by the use of a rheostat in a D.C. motor, or by brush shifting gear in a A.C. commutator motor. A constant-speed stoker motor may be run intermittently at full speed, the period for which it is run being proportional to the load on the boiler; a special starter, to be operated by the power piston, is required under these conditions. Finally, a Ward-Leonard system varying the supply voltage may be employed to control the speed of the stoker motor. The excitation current on the Ward-Leonard generator is controlled by a resistance operated by the power piston.

Pulverised-Fuel-Fired Boilers

Measurement and control of the amount of fuel fed to the burners of a pulverised-fuel-fired boiler is not as straightforward as in stoker-fired boilers for the following reasons:—

(*a*) The quantity of primary air must be measured and controlled.

(*b*) The speed of the coal feeders must be measured and controlled.

(*c*) The usual pulverised-fuel burners and mills cannot operate at very low loads, so provision must be made to serve a boiler by two or more burners and mills, one or more being cut out as steam demand falls, the load on those remaining in operation being adjusted correspondingly.

(*d*) The ratio of pulverised fuel to primary air does not remain constant at all loads, the quantity of fuel carried per cu. ft. of primary air decreasing with decrease in air velocity. For accurate control at low loads arrangements must be made to compensate this tendency.

The simplest method of control is to adjust the primary air supply in accordance with the steam demand. Simultaneously, the coal feed to the pulveriser is adjusted to maintain the correct level of fuel for the required output as determined by the primary air. (Fig. 1.) Such systems prove reasonably good, but fail to meet all the requirements noted above.

Variable-Speed Control

A more complicated system of control is by means of a Ward-Leonard generator set to vary the speeds of all the feeder motors. The actual quantity of fuel is measured by inserting an orifice plate in the induction pipe of a small positive blower direct-coupled to the feeder motor shaft. The pressure drop across the orifice, proportional to the square of the coal feed, is applied to a diaphragm and opposed by the loading pressure from the master steam controller. Movement of the diaphragm when the two pressures are not in equilibrium is transmitted through the power piston to a resistance controlling the generator voltage on the Ward-Leonard set. The fuel/air ratio is controlled by a separate regulator which operates through a diaphragm and power piston to vary the supply of primary air in accordance with the fuel supply. More detailed accounts of the system employed are given later under the descriptions of specific plants.

The main advantages of automatic control of boiler operation are:—

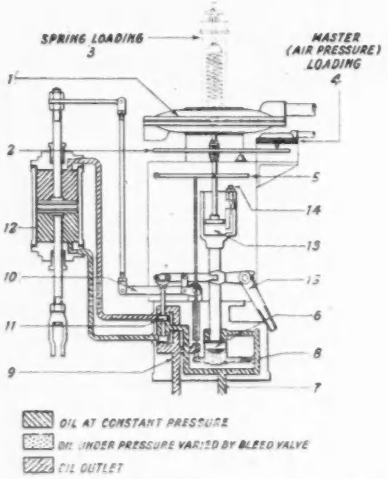
(*a*) The steam pressure is maintained almost exactly constant at all boiler ratings, the claim made being that total fluctuation in pressure in the main header is not more than ½ per cent.

(*b*) The fuel/air ratio is maintained constant and at the most efficient value found for the boiler.

(*c*) The wear and tear on furnace refractories and fittings is very much reduced because of the constant temperatures and pressures obtaining.

(*d*) A saving in fuel consumption always results. The magnitude of the saving may vary with the operating conditions; where load changes are small or slow the economy may only be about 1 to 3 per cent., but where sudden fluctuation in demand is common, savings up to 10 or even 15 per cent. have been experienced.

The actual saving in terms of cash is not easily obtained, but two published sets of figures may be quoted as giving some indication of practical results. In one installation of eight boilers driving turbo-alternators at a steam pressure of about 350 lb./sq. in., a saving of 0.075 lb. of coal per kW. generated was experienced over a considerable period. Assuming an average figure of 1.3 to 1.5 lb. of coal per kW. generated, the saving amounts to between 5 and 6 per cent. In another small power station comprising two 15,000-lb.-per-hour and two 25,000-lb.-per-hour boilers the saving in fuel amounted to slightly over 4 per cent. A marked feature in this case was the extended life obtained from the furnace refractories in spite of severe load fluctuations.



1. Measuring diaphragm. 2. Weigh beam. 3. Control or loading spring determining the constant value to be maintained, *e.g.*, furnace draught. 4. Master (air pressure) loading diaphragm employed with master controller for variable loading, *e.g.*, stoker speed and air flow control. 5. Guide beam. 6. Amplifier. 7. Oil inlet. 8. Restricting orifice. 9. Bleed valve. 10. Return motion linkage. 11. Pilot valve. 12. Power cylinder. 13. Stabiliser. 14. Adjustable orifice. 15. Manual control lever.

[By courtesy of Electroflo Meter Co., Ltd.

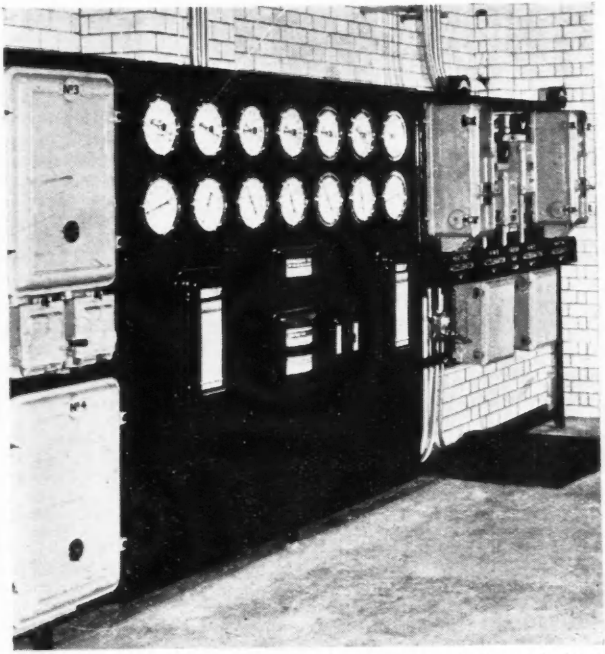
Fig. 4. Hydraulically operated auxiliary controller.

The Electroflo System

In this system, changes in steam pressure in the main header are determined by the master controller which sends out air-loading pressures to the auxiliary controllers on the induced draught fan or damper and on the fuel feeder. The auxiliary regulators operate by pneumatic or hydraulic means and comprise exact means of measurement of all the quantities under control.

The master and all auxiliary controllers work on the weigh-beam principle, the measured quantity being applied to one end and the loading pressure to the other end of the beam. In the master controller, Fig. 2, the steam pressure from the header is led to a diaphragm compartment, the steam pressure underneath the diaphragm being balanced by two springs tensioned to the exact degree required to counteract the steam pressure. Deviations from the mean pressure result in vertical movements of a rod attached at one end to the diaphragm and to the weigh beam at the other. Attached to the other end of the weigh beam is a rod carrying a cup valve which fits into a seating in the base of an air chamber. Air, at not less than 5 lb./sq. in. pressure, is fed to this chamber, the actual pressure in the chamber depending on the position of the cup valve. If the steam pressure in the header rises, the diaphragm-operated rod pushes up the end of the weigh beam which opens the cup valve, thereby setting up a lower pressure in the air chamber. Should the steam pressure fall, the cup-valve end of

the weigh beam rises and the pressure in the air chamber increases. The air chamber is connected through a change-over valve to a manifold from which two tappings are taken to each boiler. One tapping is led to the fuel-feed regulator and the other to the air-flow regulator, each being provided with an indicating manometer and a ratio valve. By means of these valves the ratio of air pressure in the two sections may be adjusted to suit any given set of conditions, while the manometer readings indicate the ratio of the air pressures in the two sections and therefore the fuel/air ratio on the boiler. Obviously the two pressures remain a fixed fraction of the cup-valve pressure, while the ratio of the two remains constant irrespective of changes in the cup-valve pressure, *i.e.*, changes in the boiler load.



[By courtesy of Elliott Bros. (London), Ltd., and "Heating and Ventilating Engineer."

Fig. 5.—Modern boiler instrument panel.

The tendency to overcorrect changes or "hunt" is obviated in the Electroflo master controller by including in the scheme an automatic steam-pressure compensator. This rebalances the operating forces during any change to establish control at the new load and at the same steam pressure. The compensator is composed of two fluid-filled chambers connected through an adjustable leak. The pressure in the air chamber, varying with changes in the boiler load, is connected to one chamber of the compensator; fitted to the second chamber is a diaphragm carrying a push rod which imposes a load on the weigh beam of the master steam controller. The load imposed on the weigh beam depends on the pressure changes transmitted through the fluid lead. The forces acting on the weigh beam of the steam-pressure controller are therefore constantly readjusted in proportion to the load changes, the claim made being that steam pressure remains at a constant value at all boiler ratings.

Auxiliary Controllers

The pressure in the air chamber of the master controller is transmitted through a manifold and various tappings to the auxiliary regulators, *viz.*, the fuel-feed regulator and the air-flow regulator. These auxiliary regulators, operating through power pistons, control the position and movements of the fan vanes, dampers, rheostats, etc., which determine the air flow and fuel feed. A feature of this system is that means of measuring the fuel and air supply are incorporated in the auxiliary regulators which exert their controlling influence in conjunction with the measured quantities. In both cases the air loading pressure from the master steam controller is applied to one end of a weigh beam. In

the air-flow regulator the differential pressure loss through the furnace is applied to the other end of the weigh beam. In the fuel-feed regulator, the master loading pressure is opposed by a pressure equivalent to the stoker speed. Attached to the weigh beam is a rod controlling the position of a bleed valve, which in turn operates the amplifier mechanism. The function of the amplifier is to determine the movement of the pilot valve by which air or oil under pressure is admitted to the top or bottom of the power cylinder. When the two forces applied to the weigh beam balance one another, the power piston remains in a fixed position. Movement of the weigh beam, from alteration in the air-loading pressure, gives rise to an increase in pressure on either the top or bottom of the power piston which moves to a new position and in so doing effects the necessary change in the mechanisms controlling the air flow or fuel feed.

Air Flow Measuremeat

Air flow is measured by the pressure drop between the combustion chamber and the last pass of the boiler, tappings being led from two suitably chosen points to a diaphragm chamber in the regulator. This pressure difference (equal to the square of the air flow) is applied to one end of the weigh beam, opposing the master air loading pressure applied to the other end of the beam. To measure the fuel feed the stoker-speed regulator incorporates an oil chamber containing a metallic disc suspended horizontally from a rod connected to the weigh beam. This chamber, fitted with radial blades cast in the base, is made to rotate by a worm and worm wheel attached to the stoker drive. The centrifugal force set up in the oil by the rotating chamber and blades exerts a differential pressure on the disc, which does not rotate, causing it to move downwards. In this way the downward pull imposed on the weigh beam is proportional to the square of the speed of rotation and to the square of the fuel feed. This force is opposed by the air-loading pressure from the master controller. The relations of the loading pressure from the master controller to the air flow and to the stoker speed, as described, are identical.

The salient features of the auxiliary controllers are the amplifier and yielding return system, which are claimed to vary the rate of operation of the regulator in proportion to the magnitude of the deviation and also to its rate of change. The amplifier is either a differential piston operating in an oil system or a diaphragm. The yielding return system is an oil dashpot or stabiliser exerting on the weigh beam a counteracting force tending to restore the bleed valve to its mean position.

(To be continued.)

Silver-Lead Solder

Substitute for High-Tin Products

DETAILS of "Comsol," a modified silver-lead solder, containing only a small percentage of tin, are given in a recent leaflet from Johnson, Matthey and Co., Ltd. Its characteristics include a melting point of 296° C., high resistance to creep at elevated temperatures, and good wetting properties. "Comsol" was developed originally for the purpose of soldering the armature end windings of electric motors to their commutator segments. For this application a solder is needed which retains its strength at the relatively high temperatures (up to about 150° C.) which are sometimes reached in the operation of modern electric motors. The soldering properties of "Comsol" have, it is stated, led to its adoption in a much wider field, and it has been found to be an effective substitute for high-tin solders in industry generally.

It flows readily and produces sound strong joints in copper and tinned iron. For bit soldering, it may be used with either zinc chloride, zinc-ammonium chloride, or resin as flux. For applications where a non-corrosive flux is essential, the use of resin is recommended; at the higher temperatures of soldering this flux is appreciably more active than when used with the ordinary tinman's solder. For blowpipe soldering, when there may be a tendency to overheat the work locally, zinc chloride fluxes are recommended; resin is liable to be charred under these conditions. Its other physical properties are: maximum tensile strength, 2.5 tons/sq. in., elongation 44 per cent., density 11 gms./c.c., Vickers pyramid hardness 11. The strength of butt joints approximates to the strength of "Comsol" in the cast condition.

The ability of "Comsol" to resist stressing at high temperatures, it is stated, can be evaluated only from the results of creep tests, and cannot be gauged by short-time tensile tests. At 150° C. tinman's solder will fail under 100 lbs./sq. in. in 10 hours; it is claimed that "Comsol" will withstand 500 lbs./sq. in. for about 250 hours, 250 lbs./sq. in. for about 1 year, and 100 lbs./sq. in. practically indefinitely.

World Mineral Resources

British Association Conference : The Atlantic Charter

A CONFERENCE on Mineral Resources and the Atlantic Charter, particularly its fourth clause which refers to access to raw materials, was held by the British Association (Division for the Social and International Relations of Science) on July 24 and 25 in the theatre of the London School of Hygiene and Tropical Medicine, London, W.C.I, under the chairmanship of the President, SIR RICHARD GREGORY, Bt., F.R.S., who opened the proceedings.

The "Haves" and "Have-Nots"

SIR THOMAS HOLLAND, K.C.S.I., K.C.I.E., F.R.S., in the first paper, gave a vivid picture of the means of general access to mineral supplies. Among the raw materials referred to in the Charter, he said, minerals were beyond question the most important because of their natural occurrence under fixed geographical conditions which could not be changed by any artificial measures. As long as difficulties were created among nations for the exchange of such raw materials, there must be potential friction between the "haves" and "have-nots." The chief steel-making countries—the United States, Great Britain, Germany, France, Italy and Japan—had little more than negligible resources of manganese ore to rely on within their own political boundaries, while the countries in which the mineral occurred in greatest abundance were but small consumers of it. Russia, however, was an outstanding exception. For many years it had been the world's chief producer of manganese and, unexpectedly to others, during the decade before 1937 increased its output of steel tenfold, thus passing from the sixth to the third position among steel-making countries. We could thus speculate with some certainty on one important reason why Germany suddenly broke her pact and invaded Russia. It was a prospective shortage of manganese rather than of petroleum which threatened disaster to Germany's munition supplies.

PROFESSOR H. H. READ, F.R.S., speaking of the geological control of mineral resources, pointed out that we had to accept the geological make-up of the crust of the earth and that mineral resources could not be created by edict, legislation, or wishful thinking. A change in mineral distribution was not within our power and since not even a combination such as the United Nations would be self-sufficient, Clause IV of the Atlantic Charter was relevant.

PROFESSOR C. B. FAWCETT, in his lecture on "Key Metals and the Location of Industry," said that the key metals were those used chiefly in forming, with iron, most of the steels which are now used. Most important of these key metals were chromium, cobalt, manganese, molybdenum, nickel, tungsten, and vanadium—a list which was far from being exhaustive. The sources of these key metals were, for the most part, in remote and thinly populated areas, but the place of occurrence had little or no influence on the location of the industry which used them. The factors influencing the location might be grouped as: Economic (transport and power needed): Social (amount and kind of labour): and Political (importance for armaments industry and tools which produce armaments). "Scrap" was already a substantial part of the immediate raw material of these industries.

PROFESSOR P. G. H. BOSWELL, F.R.S., who entitled his lecture "Some General Reflections from a Geologist," remarked that in assessing the world's resources of essential minerals, our information dated from pre-war days. Reassessment was necessary, but could only be effectively undertaken after the war. Complete data to serve as a guide for post-war planning could only be compiled by an international commission, but such a body, if suitably financed, could do good work meanwhile.

SIR WILLIAM LARKE, K.B.E., presiding at the first afternoon session, said, that in these days of ever-increasing rapidity of transport, under peace conditions it would seem to be possible for all nations to obtain access to the raw materials they require, irrespective of their geographical location, if willing to pay the world price for them. Clause IV of the Charter, being a pledge that no restriction should be placed on access to raw materials, might have a more important bearing on the future than we at present realised, since in the light of present knowledge the deprivation of certain metals would make a nation almost defenceless against others that could obtain them.

The World's Tinfields

PROFESSOR W. R. JONES said that the world's tinfields could be resolved into a few groups, conveniently termed "metallogenetic tin provinces," in which the tin mineralisation with respect to each group had been effected at the same time and under similar conditions. Outside these provinces, no tin deposits of economic importance were known and the evidence was almost conclusive, that only in those few parts of the earth's crust were conditions suitable for the deposition of cassiterite, the source of almost all the world's tin. Few tinfields remained to be discovered but greater attention would be devoted to lode mining on a larger scale and to more efficient methods of recovering the tin concentrates.

SIR LEWIS FERMOR, O.B.E., F.R.S., speaking on manganese ore deposits, said that it seemed clear that pre-war arrangements were adequate to enable every country fitted by nature for the production of iron and steel to obtain by honest trading and purchase at fair rates in the world's markets the supplies of manganese ore needed.

A statistical analysis of other minerals on the basis of pre-war statistics would lead to a similar conclusion. If that proved to be the case, then all that Clause IV of the Atlantic Charter could mean in the respect of minerals was that it was intended to restore pre-war freedom of international trade, breaking down such barriers as existed. It would be necessary, however, to prevent for a period the free passage of minerals and other raw materials of use for armaments to the Axis countries in excess of their requirements for peaceful industrial purposes.

LT.-COL. THE HON. COLIN CAMPBELL, M.L.A., dealt with nickel, which, he said, should be included in this discussion of world resources, being one of the most essential metals for the maintenance of the standard of living at the present level now considered necessary in the more advanced countries. He emphasised that the nickel required by the post-war world would still largely come from Canada; though during our lifetime a high proportion would come from New Caledonia. The two producing companies are the International Nickel Company of Canada, Ltd., and the Falconbridge Nickel Mines, Ltd. At the present time the refineries in Norway were in enemy hands and the refining of Falconbridge nickel was carried out by the International Nickel Company. This Company is also treating the matter produced in New Caledonia since the French refinery is also not available.

Aluminium Figures

MR. M. P. FOGARTY spoke of aluminium, of which the world output from 1937 to 1941 had approximately doubled, reaching just under a million tons. It is reckoned that by the end of 1942 the industry may be able to produce more than 1¾ million tons a year, mainly because of large extensions in the United States, and there is reason to think that it may increase still further. In the fast development of aluminium production and consumption Great Britain had also taken a part. More economic use was being made of scrap, and wider use was being made of aluminium down to about 98 per cent. purity where formerly 99 per cent. and upwards was being specified. Research work was being carried on by the Air Ministry, technical organisations and several large firms. A new Wrought Alloys Development Association was formed at the end of 1941 to provide information about aluminium and magnesium alloys to assist the war effort, and to advise industry on the use of those alloys in peace-time. Considerable progress had been made in discovering new fields where aluminium might be applied and in improving the technique of manufacture. But it also appeared likely that much more use would be made of corrosion-resisting iron and steel after the war, and, from the point of view of technique, aluminium and corrosion-resisting iron and steel were directly competitive in a number of uses. The crucial question for the users of aluminium was its price; this depended partly on technical factors, of which the most important was the cost of power. It had been proposed that after the war a number of specialised trading estates might be established on which electro-chemical and electro-metallurgical industries could be grouped around a power station in such a way as to minimise power costs. If the relative price of aluminium could be cut in this country as vigorously as it has been and may be in America, it should be possible after the war to use at any rate the greater part of the present output.

New Metal Technology

DR. C. H. DESCH, F.R.S., presiding at the second morning session, gave an address on "New Metals and New Methods." The development of modern industry had brought with it remarkable qualitative changes, he said: elements which until lately were curiosities of the laboratory had come into the limelight of industries. Important developments in metallurgy depended on the use of comparatively rare metals, mostly found only in local concentrations. The first recognition partly accidental, that steel could be made to resist corrosion by incorporating 14 per cent. or so of chromium led to the important class of stainless steels, while the new magnet steels, containing aluminium and nickel, had brought about a revolution in the construction of electrical instruments, loud-speakers, etc. Tungsten, with its high melting point of 3650 deg. C., had superseded all other materials for the filaments of electric lamps; an alloy of osmium and iridium formed the exceedingly hard and incorrodible substance for the nibs of fountain pens; tantalum had proved specially suitable for the spinnerets used in making artificial silk; rhodium and indium for depositing in thin layers on other metals for protection against corrosion; the non-metal selenium in photo-electric cells. Further uses of this kind would present themselves as the properties of the rarer elements were studied more completely. A new branch of technology, known as "powder metallurgy" had grown up; materials for furnace construction and for containing vessels which were both strong and resistant to chemical attack at very high temperatures had been found; modern heating by induced currents of high frequency allowed the heat to be generated within the mass to be heated; melting in a vacuum out of contact with furnace gases gave a means of preparing many substances in a state of great purity and soundness and other chemical reactions were made possible or were accelerated by high pressure; the manufacture of plastics was one of the growing industries, and the uses of these new materials were continually being multiplied. As new materials came into use and new techniques were developed, while at the same time the known reserves of some indispensable metals were being depleted, it became clear that the efficient use of the world's mineral resources demanded systematic planning. A far more thorough

world-survey was needed, to gather the information collected by prospectors in the interest of large industrial corporations as well as by the various national surveys, and thus to form the basis of a system of international control.

DR. E. F. ARMSTRONG, F.R.S., on "Minerals, Old and New, from the Sea," described the extraction of common salt, potash, bromine and magnesium from the sea by methods which were both novel and interesting, and their further working up into pure materials. Although there was clear evidence that other useful materials must be accumulating in the sea, notably phosphates, no way had yet been found to extract and concentrate them economically. The chemists were already searching for materials capable of selectively absorbing and retaining substances present in small quantities in large volumes of water. The advantage of the sea as a source of minerals was that there is free access to it for any country which has a coastline. Its use, therefore, comes under the Clause IV of the Charter.

Dead Sea Minerals

DR. ERNST BERGMANN described the Dead Sea and its surroundings which have played a modest role since 1930 in the supply of potassium salts, magnesium salts, and bromine. With the outbreak of this war, its importance had suddenly grown, as the main previous production centres of those three vital materials were now in Axis hands. He gave a brief but comprehensive estimate of its future possibilities and also emphasised that the mountains separating Judaea from the Dead Sea consisted to a large extent of a bituminous limestone. Approximately 24,000,000 tons of this stone were available, containing up to 20 per cent. organic matter and giving, by destructive distillation, up to 11 per cent. of its weight in form of a shale-oil which could be used to generate the power and to form the fuel required for the prospective development of the Dead Sea. In this respect he also mentioned, that in the Gaza area in Southern Palestine a large sulphur deposit had been discovered, representing, by an approxmate valuation, at least a million tons of sulphur, so that all the sulphuric acid could be made from local raw material. The Transjordanian shore of the Dead Sea had considerable phosphate deposits, while on the Palestinian side large deposits had also been studied, representing a somewhat less concentrated tricalcium phosphate, namely, of 43-56 per cent.

DR. W. H. HATFIELD, F.R.S., presented a paper on "Economy in the Use of Ferro-Alloys," dealing with all the twenty-five elements of interest in Steel Metallurgy, which can be divided substantially into four groups. Britain relies on importing 30 per cent. of her iron ore and the whole of her manganese, chromium, nickel, tungsten, molybdenum, vanadium, and cobalt. In May, 1940, the Special and Alloy Steels Committee constituted its Technical Advisory Committee with a mandate to deal with the problem of steel metallurgy. It was found that the production of steels was governed by 2000-3000 specifications. In 1941 advantage was taken of the existence of the British Standards Institution to issue document BS 970 1941, followed by BS 971. The problem is a considerable one, namely, how at the present time to cater for a greatly increasing demand for steels of the necessary properties with a changing availability and a considerable deficiency in some of the essential elements. Never has a more interesting technical situation developed for solution by scientific and technical minds.

DR. DAVID WILLIAMS read a paper on "Mineral Resources of the U.S.S.R.," the development of which, during the past 15 years, had far surpassed anything formerly achieved in a like period of the world's history. Russia's immense reserves of coal, iron and petroleum afforded a sure basis for industrial progress, and in each of these three most important commodities she was capable of long maintaining a surplus output.

Scrap Recovery

SIR HAROLD HARTLEY, C.B.E., F.R.S., closed the morning's proceedings with an address on "The Recovery of Metals from Scrap," giving the definition of scrap, describing the disposal of scrap and outlining the relationship between total production and scrap recovery. His data made it clear that scrap recovery would be of increasing importance in the conservation of our metal resources, and that as a major source of raw materials it must be brought into a general scheme.

Saturday afternoon's session, opened by an address of its chairman, the RT. HON. SIR STAFFORD CRIPPS, Lord Privy Seal, was devoted rather to the economic and financial sides of the question, as distinct from the chemical or metallurgical, and, to conclude, the chairman proposed the following resolution which was unanimously adopted :—

That this Conference request the Council of the British Association to consider means by which the Association could assist in the carrying out of the Fourth Article of the Atlantic Charter, which postulates access for all States on equal terms to the raw materials of the world.

This Conference, having specifically dealt with mineral resources, submits that, as a first step, the Council should initiate forthwith consultations with appropriate scientific and technical organisations, to secure an understanding on the principles involved. The Conference would further urge that a scientific review of mineral resources, using and supplementing all existing data, should be among the first tasks of any international organisation for the social applications of science.

Oil and Colour Chemists

Annual Association Meeting

THE annual general meeting of the Oil and Colour Chemists' Association was held at the Charing Cross Hotel, London, on July 23. Mr. W. E. Wornum, who was in the chair, was re-elected president, and the following officers were appointed (re-elected unless otherwise stated): vice-presidents, Mr. E. J. Bond (new appointment), Mr. H. Clayton, Dr. L. A. Jordan, Dr. G. L. Riddell, Mr. S. K. Thornley; hon. secretary, Mr. C. W. A. Mundy; hon. treasurer, Mr. H. D. Bradford; hon. editor, Mr. G. N. Hill (formerly vice-president); research and development officer, Dr. J. O. Cutter. Dr. R. F. Bowles, Mr. H. J. Gorer, and Mr. R. J. Ledwith were elected to the Council, after a ballot, in place of Mr. G. F. Jones, Mr. F. Sowerbutts, and Mr. D. Wait, who offered themselves for re-election. The annual report of the Council noted three major developments during the year: the formation of a new Section at Newcastle-on-Tyne; the setting up of a Technical Advisory Council to assist in the war effort; and the work of the Technical Education Committee, which provides the foundation for a scheme for technical education in the paint industry. Membership increased by 37 during the year, and now stands at 719.

Technical Knowledge Mobilised

In his statement on the work of the Association, the president said that the Council had decided to constitute the Technical Education Committee a Standing Committee of the Association. A very valuable report had been framed by Mr. G. A. Campbell covering the main aspects of the problem. He also emphasised the value of the post-graduate courses of lectures which had been arranged by the London Section. Passing to the Technical Advisory Council, the president said that early this year it became evident that something had to be done by the chemists in the industry to face the raw-material position. There was a vast amount of technical knowledge and experience within the Association which, if properly mobilised and directed in the national effort, would be of great value. The result of their efforts was the appointment of the Technical Advisory Council which had approached a large number of technical advisers, all experts in some particular field. It was necessary to maintain a certain amount of secrecy and, therefore, he asked members to maintain patience at the moment because he could not give much detail. Personally, he felt that this Technical Advisory Council had come to stay after the war. It would be the means of ensuring that the scientist entered more and more into the government of the industry and of the country as a whole; a great deal depended on the way he played his cards and the confidence he was able to instil into those with whom he co-operated. Mr. R. J. Ledwith, Dr. H. W. Keenan, and Mr. R. S. Baker also took part in the discussion, and Mr. G. Copping recalled a suggestion made in the London Section that a Paint Trade Scholarship should be established in memory of the late Mr. F. W. Clarke. He had already received a good sum of money towards this. The aim was £1000, and the money would be handed over to the Education Committee.

Eire Scientific Bureau

Varied Programme of Research Work

EIRE'S Emergency Scientific Research Bureau is now costing £19,000 per annum, an increase of £7000 on last year's expenditure, according to the Eire Prime Minister (Mr. de Valera) when he reviewed the work of the Bureau in the Dáil recently. He indicated that the Bureau was concentrating mainly on those problems which seemed likely to be overcome by short-term research.

Organic Acid Shortage

Mr. de Valera referred to the establishment of a plant for producing compressed ammonia and formalin (already reported). The tanning industry, he continued, had benefited from experiments in processes for the production of sulphonated oil and sodium sulphide from indigenous materials, while investigations on the manufacture of various organic acids to meet the shortage of imported tartaric and citric acids had shown that tartaric acid could not be produced in Eire on the scale required. A process had, however, been developed for the production of phosphoric acid, which could replace organic acid for some purposes, and the Bureau was still working on the production of citric, lactic, and mucic acids. Spent oxide from gasworks might be made to yield sulphur for use in existing plants for the production of sulphur dioxide and sulphuric acid.

New Manufactures Started

Other successful work included the manufacture of aluminium sulphate, the replacing of medicinal glucose by invert sugar solution, the manufacture of zinc oxide (now being produced in Dublin at the rate of 10 cwt. per week), and the development of formulæ for the preparation of creosote disinfectant, axle grease, and fatty acids required in rubber manufacture from indigenous oils. Investigations in progress included the manufacture of carbon black and certain essential medicaments.

A few days later, when discussing Eire's post-war programme, Mr. de Valera said that a Scientific Research Bureau should be a permanent organisation in the State.

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The Alkaline Earth Metals and their Alloys

Increasing Technical Importance

by OTTO EINERL, Dr. Eng., and FREDERIC NEURATH, Ph.D.

ALTHOUGH the alkaline earth metals, calcium, strontium, and barium have been known since the beginning of the 19th century (having been prepared experimentally, by way of their amalgams, in 1808 by Davy, five years after his discovery of magnesium), their technical production began much later than that of aluminium and magnesium.

Difficulties of Production

This is easily understood, because the fusion electrolysis of calcium chloride on a technical scale is one of the most difficult of all electrolytic operations and requires an accuracy of control greater than that of the other electrometallurgical processes. The difficulty is not so much the production of calcium itself, but the fact that calcium, in spite of its not very high melting point (810° C., by the latest determination) reacts at elevated temperatures with practically all elements except the noble gases. Another difficulty arises in its separation from calcium chloride during fusion electrolysis. As the melting point of calcium chloride (768° C.) is lower than that of metallic calcium, the calcium is deposited in the molten state, but it must be separated from the still liquid calcium chloride in the solid state. This is done by means of continuous deposition and freezing on the cathode, the movement of which must be so adjusted and regulated that it correcponds with the deposition of the calcium.

The conditions for the two other alkaline earth metals are just the opposite, as the melting point of strontium (757° C.) is lower than that of strontium chloride (840 C.) or of the mixture of strontium chloride and potassium chloride which is mostly used for the fusion electrolysis of strontium. Barium has a melting point of 704° C. compared with a melting point of 960° C. for $BaCl_2$.

The electrolytic potentials of the alkaline earth metals based upon hydrogen are: Ca, 2.5 volt; Sr, 2.7 volt; Ba, 2.8 volt.

Strontium can be produced not only electrolytically, but also by an aluminothermic process and subsequent distilling *in vacuo*. Barium is produced by processes similar to those used for strontium or by heating barium oxide or barium hydroxide with aluminium or magnesium and subsequent separation by vacuum distillation.

Pure Alkaline Earth Metals

Calcium is technically produced with approximately 99 per cent. Ca content. The main and very annoying impurity of the technical product is the adhering $CaCl_2$ film, and when calcium is required for special purposes at a purity of more than 99 per cent. it must be distilled *in vacuo*. The danger of the calcium chloride film is its hygroscopic character. The metallic calcium takes on moisture before it is packed in sealed metal containers or when these are opened. In general, however, the metallic calcium which is free from $CaCl_2$ is comparatively inert, the bulk being protected from oxidation by a layer of CaO, so that calcium can be stored in metal containers without danger of gas evolution.

Pure alkaline earth metals have a yellowish-white colour; they are very soft and their specific gravities are: Ca, 1.55; Sr, 2.64; Ba, 3.66. Nordmeyer and Bernouilli found (1906) the specific heats to be as follows: Ca, 0.149; Sr, 0.073; Ba, 0.068.

Calcium occurs very frequently in nature in its various compounds and occupies, with 3.4 per cent., the fifth place for abundance among the elements, com-

ing after aluminium (7.5 per cent.) and iron (4.7 per cent.). It occurs naturally in combination with oxygen and other elements, chiefly silicon and aluminium. The most abundant calcium mineral, however, is the carbonate (calcite, aragonite, marble, limestones of various kinds, and chalk).

Strontium, on the other hand, is not common. It was originally located as a peculiar mineral in the lead mine of Strontian in Argyllshire and was examined by Hope in 1791, by Kirwan and by Klaproth in 1793. They concluded that this mineral was the carbonate of a new earth, to which Klaproth gave the name of strontia. Talbot observed the red metallic emission lines of strontium in 1826. The mineral called strontianite is the carbonate, $SrCO_3$. Strontium sulphate, $SrSO_4$, occurs as the mineral celestine, so called from the pale blue colour of some specimens from near Yate (Bristol).

Barium, the name of which is derived from the Greek word for heavy, is much more widespread and occurrences are known in many countries throughout the world. The mineral heavy spar, barytes, or barite, is a very common vein in lead mines; it consists mainly of barium sulphate and is associated with galena, calcite, fluorite, and quartz. (The miners call it "cawk.") Barium also occurs as the carbonate $BaCO_3$, the mineral witherite, isomorphous with aragonite, found as a gangue material in lead veins.

Industrial Production

Calcium metal, which was first obtained by Moissan in a pure state in 1898, has been produced in technical quantities since about 1912 in Germany (Griesheim-Elektron, Bitterfeld) and France (Société de l'Electrochimie, Jarrie, Isère). But the largest and most modern plant was erected as recently as 1939 in the United States, to make America independent of her former imports from France. These works were started by the Union Carbide Company in co-operation with the Electro Metallurgical Company at Sault St. Marie (Michigan). The price of calcium metal is $1.25 per lb., equivalent to about £630 per ton. The total world production in 1939 reached hardly 50 tons, but has since increased considerably. Apart from metallurgical applications, metallic calcium is used for drying organic substances, *e.g.*, absolute alcohol, in removing the last traces of air from high vacua, and in separating argon from nitrogen.

Strontium metal has been obtainable in the U.S.A. since 1929, the present price being 88-10 per lb. Strontium as a metal is fairly insignificant compared with the many applications of strontium salts. These are used not only in sugar refineries (the hydroxide forms with cane sugar a sparingly soluble compound $C_{12}H_{22}O_{11}.2SrO$, which can so be separated from the molasses), but are also important in the manufacture of tracer bullets, red flares, fireworks, torches and signal lights. Strontium sulphide is fluorescent, like calcium sulphide, and is much used for luminous paints. Strontium metal must be stored under toluene. Barium metal, first produced in the pure condition by Guntz in 1901 by using the reaction $3BaO + 2Al = Al_2O_3 + 3Ba$, has been produced on a technical scale since 1929 in Germany and France with a purity of 99.8 per cent. Ba by the same concerns as manufacture calcium. Barium metal has to be stored in an atmosphere of argon as it reacts with carbon dioxide.

Crystal Structure

At ordinary temperatures calcium, like strontium, exhibits the crystal structure of a face-centred cube, while barium has the crystal structure of a body-centred cube, like the alkali metals. At higher temperatures, however, critical points have been established and calcium has an α-modification up to 300° C., a β-modification between 300° and 450° C. and a γ-modification between 450° C. and the melting point. For barium a critical point has been found at 375° C.

Alloys of Calcium with Light Metals

(a) *Calcium-magnesium.*—An intermetallic compound Ca_3Mg_4 exists in the system Ca-Mg and between the compound Ca_3Mg_4 and pure magnesium is a eutectic with 16.2 per cent. Ca.[1] Small quantities of calcium effect a grain refinement of magnesium and improve its mechanical properties in a similar way to the effect of cerium addition. Additions ranging up to 0.25 per cent. Ca result in an improved surface on many types of electron castings with retention of a refined grain condition combined with reduction of the time for heat-treatment, as the calcium addition permits the applica-

tion of higher heat-treating temperatures. The addition of calcium is done by wrapping a piece of calcium of the required weight in a net of iron wire and plunging it beneath the surface of the magnesium alloy. Among the wrought magnesium alloys, which have been developed recently with an addition of silver, some can be quenched and age-hardened, *e.g.*, 8-8.5 per cent. Al, 2.5-3 per cent. Ag, 0.4 per cent. Mn, 0.2 per cent. Ca, balance magnesium. This alloy has an exceptionally high proof stress of 17 tons/sq. in., 25 tons tensile strength, and 4 per cent. elongation. Calcium-magnesium alloys have also been used for the manufacture of porous cement (gas concrete).[2]

(b) *Calcium-aluminium.*—There exists an intermetallic compound $CaAl_2$, and between this and pure aluminium there is a eutectic alloy with about 8 per cent. Ca.[3] Up to 0.5 per cent. Ca a solid solution of calcium in aluminium is assumed. In the United States calcium addition is applied to Duralumin to increase its hot-rolling capacity. Calcium does not act well as a deoxidising admixture in aluminium alloys, because it burns away and forms a tough bluish skin. Calcium has also been recommended for refining purposes in the melting of secondary aluminium, but the results are variously interpreted. On the other hand calcium appears as constituent of the German aluminium alloy "Montegal" (Metallgesellschaft Frankfurt a/M), which is a rolling and forging alloy used especially for electric overhead lines. As there is also a silicon content in this alloy, it is dealt with below. The binary Ca-Al alloys, between the eutectic alloy with 8 per cent. Ca and the compound $CaAl_3$ with 33 per cent. Ca, are used as deoxidisers for steel. "Calloy" (Calloy, Ltd., Avonmouth) is on the market with the compositions 8-12 per cent. Ca., 88-92 per cent. Al, and 24-26 per cent. Ca, 74-76 per cent. Al.

(c) *Calcium-silicon.*—The existence of a compound $CaSi_2$ is not fully ascertained, though its constitutional diagram has been set up.[4] Calcium-silicon and calcium-manganese-silicon alloys are often applied in the usual practice of steel deoxidation. Calcium silicide, produced electrothermically, contains 25-30 per cent. Ca and 65-70 per cent. Si.

(d) *Ca-Al-Si.*—The combination of the systems Ca-Al and Ca-Si to the ternary system CaAl-Si has also been investigated.[5] The ternary system includes the intermetallic compounds $CaAl_3$ and $CaAl_2$. A ternary alloy with 0.5 per cent. Ca, 11.6 per cent. Si and 87.9 per cent. Al was found to be a ternary eutectic recalling the silicon aluminium alloys of the type L33 modified by sodium: the alloys of the type Al-$CaSi_2$ can in fact be grain-refined by adding sodium. In this category belongs the alloy "Montegal" already mentioned. This contains 0.8 per cent. Si, 1 per cent. Mg and 0.2 per cent. Ca, balance aluminium. It is the function of the Ca addition to deprive the hardening constituent $MgSi_2$ of its silicon and so to prevent age-hardening. In any case it has to hinder the undesired silicon surplus from forming mixed crystals with aluminium, because the electrical conductivity improves with the decrease of the solid solution of Si in aluminium.

(e) The system *Ca-Mg-Si* has been studied,[6] but appears to be of no special significance.

Alloys of Sr and Ba with Light Metals

(a) *Strontium-magnesium.* — Between an intermetallic compound $SrMg_9$ and pure strontium is a eutectic alloy with 18.4 per cent. Sr, the melting point of which is 582° C. The solubility of strontium in magnesium is 0.15 per cent. Sr at 500° C.[7]

(b) *Strontium-aluminium.*—This system is only incompletely examined.[8] Alloys with Sr contents up to 50 per cent. Sr are being manufactured by a factory in England.

(c) *Barium-magnesium.*—In the system Ba-Mg the intermetallic compounds $BaMg_2$, $BaMg_4$, and Ba_2Mg_3 have been established.[9] A eutectic alloy with 13.8 per cent. Ba (melting point 618° C.) exists between $BaMg_2$ and pure barium. Barium-magnesium alloys are being produced by Calloy, Ltd., with 25-30 per cent. Ba and 70-75 per cent. Mg under the trade name "Barmag" for wireless valve manufacture.

(d) *Barium-aluminium* in the system Ba-Al is a eutectic alloy with 2 per cent. Ba between pure barium and the intermetallic compound $BaAl_4$.[10] Alloys with 45-50 per cent. Ba, balance aluminium are on the market under the trade name "Baral" (Calloy, Ltd.) and are used for wireless valves in the same way as "Barmag."

Among the alloys of calcium, strontium and barium with heavy metals those

with lead are already of major importance, especially as a wide field of tin-free bearing metals is thereby opened.

Alloys with Lead

(a) *Calcium-lead.*—In the system Ca-Pb the intermetallic compounds Ca_2Pb, CaPb and $CaPb_3$ have been established.[11] Calcium in lead with 0.1-0.25 per cent. Ca, balance lead, is not only of real economic importance, but also of strategic value. The addition of calcium to lead improves its tensile strength, hardness, and endurance limit. Alloys for cable sheathing and for grids and plates of accumulator batteries (0.25 per cent. Ca) belong to this category.[12] For the production of these alloys calcium metal is not used, but a hardener of calcium-lead alloy, which is obtained directly by calcium deposition in the lead either by electrolytic means or by dissociation of calcium carbide in lead. The calcium-containing lead base bearing metals are of major interest. The German bearing metal "Bahnmetall" (Metallges. Frankfurt a/M. and Schaefer and Schael, Breslau), with a Brinell hardness of 34, consists of 0.75 per cent. Ca, 0.6 per cent. Na, 0.04 per cent. Li (or instead of Li small quantities of Si and Al), balance lead. The English bearing metal "Satco Metal" (Hoyt Metal Co., London) is similarly composed. It contains 0.5-2 per cent. Sn and, besides 0.5 per cent. Ca, small quantities of Li,K,Mg,Al, and Hg. This bearing alloy has a melting point of 315° C., an excellent bearing life, and sufficient hardness even at high temperatures. (Brinell hardness 24-27 at 20° C. against 10-14 at 150° C.).

(b) *Barium-lead.*—In the system Ba-Pb a eutectic alloy exists containing about 4.5 per cent. Ba with a melting point of 282° C.[13] Barium-lead alloys between the eutectic alloy and pure lead have gained technical importance. "Lurgi Metal" (Metallges. Frankfurt a/M) is a German bearing metal with 2 per cent. Ba and 98 per cent. Pb. It has a Brinell hardness of 30, but oxidises easily and it was found that the best results can only be obtained with ternary alkaline earth metal-lead alloys.[14] An improvement of the "Lurgi Metal" resulted therefore by substituting barium partly by calcium. Another Lurgi metal is in use with 2.8 per cent. Ba, 0.4 per cent. Ca, 0.3 per cent. Na, balance lead.

(c) *Ca-Ba-Pb.*—The eutectic of the Ca-Ba-Pb alloys melts at 284° C.[15] and solid solutions containing up to 0.2 per cent. Ca and up to 0.4 per cent. Ba are formed. The structure of these ternary alloys consists of homogeneous grains of lead (with solid solutions of calcium and barium as mentioned above) surrounded by a eutectic of solid solution with the compound $BaPb_3$ together with $CaPb_3$ crystals, embedded in a ground mass of solid solution and eutectic. Here are listed the bearing metals "Ulco Metal" and "Frary Metal" (National Lead Co., New York) with max. 1 per cent. Ca, max. 2 per cent. Ba, besides an addition of 0.25 per cent. Hg, balance lead. "Frary Packing-Ring Metal" contains 0.5 per cent. Ca, 0.8 per cent. Ba, 0.2 per cent. Cu, 0.16 per cent. Fe, balance lead.

(d) *Strontium-lead.*—There is a eutectic alloy with a very low strontium content (Sr is insoluble in lead) between pure lead and the intermetallic compound $SrPb_3$.[16] A bearing metal in this class is known as Methesius metal.

(e) *Higher systems with lead.*—All three alkaline earth metals are contained in the bearing metal "Can" with 1.75 per cent. Ca, 1 per cent. Sr, 1 per cent. Ba, 0.1 per cent. Na, 1.35 per cent. Cu, besides 94.9 per cent. lead. An alloy described in B.P. 272,889 of 1927 contains 0.35 per cent. Ca, 0.3 per cent. Sr, 0.5 per cent. Cu, 0.4 per cent. Na, balance lead, which hardens up to a Brinell hardness of 40 by means of heat treatment. A Sr-Sn-Pb alloy is described in U.S.P. 2,013,487 of 1935. This bearing metal contains 0.2-0.6 per cent. Sr, 0.2-2 per cent. Sn, balance lead. These alloys are mostly manufactured electrolytically from molten chlorides, using a cathode of molten lead. They are used in the same manner as tin-containing white metals. For several days after casting these types of bearing alloys harden, but the process can be accelerated by heating to 100°C. In view of the present shortage of tin, all these alloys are of great importance.

(f) *Calcium-magnesium-lead.* — The system Ca-Mg-Pb, with the intermetallic compound Mg_2Pb, which is also contained in the binary Mg-Pb system, might also gain more importance in the future. A eutectic alloy with 2.3 per cent. Mg, 0.5 per cent. Ca, balance lead, has a melting point of only 250° C.[17]

Here belongs the "Union Bearing Metal" with 0.2 per cent. Ca, 1.5 per cent. Mg, and 98.3 per cent. Pb. Further additions of tin and sodium are contained in the "Satco Metal" for connecting-rod big-ends and bearings (Hoyt Metal Co.), with 0.6 per cent. Ca, 0.15 per cent. Mg, 0.5 per cent. Na, besides 2.5 per cent. Sn and 96 per cent. Pb.

Alloys with Zinc

(a) *Calcium-zinc.*—In this system the intermetallic compounds $CaZn_{10}$, $CaZn_4$, Ca_2Zn_3, and Ca_3Zn_2 are established.[18] Alloys belonging here are practically applied, especially a commercial one with 35 per cent. Zn and 65 per cent. Ca, for the manufacture of porous cement and as a reducing agent in organic processes.

(b) The system *Ca-Mg-Zn* is dealt with in the same publication by Päris,[18] who has identified a compound $Ca_4Mg_3Zn_2$. Possible applications for these alloys have hardly been tried, and the same can be said of the system Ba-Mg-Zn.[19] Ger. P. 375,244 mentions that these alloys can be heat-treated.

(c) The system *Ba-Mg-Zn-Pb* has been studied in Germany to some extent, but nothing has so far been published, although Ger. P. 363,127 mentions bearing alloys belonging to this system. Additions of aluminium have also been investigated.[20]

Alloys with Tin

In the system *Ca-Sn* an intermetallic compound $CaSn_3$ has been found.[21] Calcium-tin alloys have been recommended as degassing and reducing agents in the melting of impure bronzes. Strontium-tin alloys are used as deoxidisers for copper as well as for the introduction of Sr and Sn into other alloys.[22]

The nature of the influence that the alkaline earth metals have on copper is not yet clear. Calcium forms with copper an intermetallic compound $CaCu_4$, and there exists also a eutectic alloy containing about 5 per cent. Ca. Strontium behaves with copper in a similar manner.

Alloys with Iron, Nickel and Chromium

Calcium is used in the steel industry for the manufacture of particularly clean "stainless" steels. The addition of calcium to a steel bath or to a ladle is in itself something of a problem, but it is practically employed in U.S.A. as a "final addition." This method is being applied especially for the production of high grade structural steel, and it is pointed out that this process allows a minimum of inclusion stringers and other hardly noticeable ghosts. This effect of calcium on steel is presumably to be based on its readiness to combine with oxygen and nitrogen, but it is also possible that the last remains of sulphur in the steel are transformed into a harmless sulphide by adding calcium, or that changes with other non-metallic enclosures (SiO_2) may occur. At any rate the calcium addition is regarded as desirable for all the steel specifications of the Society of Automotive Engineers in U.S.A. (S.A.E. Spec.).

Nickel-barium alloys containing up to 1.5 per cent. Ba are ductile and can be worked cold into fine wire or ribbon. These alloys have a much greater thermionic emission than pure nickel and they are being used for the construction of the base wires of barium oxide or strontium oxide coated cathodes in radio valves.[23] Barium-containing nickel exhibits also greater resistance to the action of hot corrosive gases. Ba-Ni alloys and Ba-Ni-Cr alloys are therefore used in the automobile industry for the production of ignition equipment.[24]

Acknowledgment is due, for the description of the modern process for the production of calcium metal, to the chapter "Calcium" (in French, by G. Chaudron, Lille), in the book, *Reine Metalle*, by A. E. van Arkel. (Springer, Berlin, 1939) and to an article by A. B. Kinzel: "Calcium Metal Production, a new American Industry," in *Mining and Metallurgy*, New York, October, 1941 (*see* THE CHEMICAL AGE, **46**, 1185, p. 140).

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Beryllium Copper

Good Hardness and Fatigue Resistance

BERYLLIUM, although known to the chemist and metallurgist for more than a century, is a metal which had assumed no great importance up to the last few years, having been looked upon more or less as a curiosity on account of its extreme lightness and the difficulty of extraction from its ores. The main source of beryllium—the mineral beryl—has been recognised as a semi-precious stone from early ages and is fairly widely dispersed throughout the earth's crust, though nowhere in massive quantities.

The discovery of the alloying properties of beryllium and its effects upon other metals is one of the outstanding achievements of metallurgical science. This discovery may be compared from the metallurgical, if not the economic point of view, with the ages-old observation of the effect of carbon on iron. The addition of carbon to iron transforms iron into steel and the steel may be hardened to an extent which has made the modern mechanical age possible. Beryllium transforms copper or nickel into alloys with hardness comparable to that of steel. Previously it had not been possible to harden copper to any extent, and certainly not to a degree which would permit a good cutting edge or a hard wearing surface to be obtained. This advancement is achieved by the addition of only 2 per cent. of beryllium. Not only does beryllium confer hardness on copper or nickel, but it increases its resistance to "fatigue."

Fewer Breakdowns

Beryllium copper will stand reversing operations such as are met with in the operation of springs or flexible diaphragms for a longer time than any other known non-ferrous alloy. Under corroding conditions, for instance, when salt spray is applied, the alloy actually has a greater fatigue strength than any other material, not excluding steel. The importance of this factor in the life of instruments can easily be appreciated, for it means fewer replacements, fewer breakdowns, and a longer working life. Beryllium copper alloys are similar to steel in another respect. They can be made soft or hard at will, and the soft metal can be hammered, pressed, machined, or shaped in any way with the greatest facility, after which, by a simple heat-treatment, the hardness required may be developed in it.

The difficulty of extracting beryllium from beryl is overcome for commercial purposes by reducing the metal into a matrix of copper or nickel, giving a "master" alloy with comparatively low beryllium content at an economic price, which can be satisfactorily utilised for making up the finished alloys. Pure beryllium metal is expensive to produce and is seldom used, one of its few applications being for X-ray windows, thanks to its almost complete transparency to X-rays.

A very important usage of beryllium copper is in the shape of hand tools. These have the special property of being non-sparking and, in consequence, are used in place of steel where explosives or inflammable gases, liquids, or materials are being handled. Prior to the introduction of beryllium copper such tools were made from work-hardened copper alloys which were comparatively soft and necessarily had a very much shorter life. These tools, being basically copper, are also non-magnetic.

New Standard Steels

Samples Analysed

The Bureau of Analysed Samples, Ltd., announces two new British Chemical Standard steels, as under:

13 PER CENT. CHROMIUM STEEL No. 211.

	per cent.
CHROMIUM	13.81
CARBON	0.247
SILICON	0.29
SULPHUR	0.010
PHOSPHORUS	0.017
MANGANESE	0.34

0.3 PER CENT. LEAD STEEL No. 212.

	per cent.
LEAD	0.28
CARBON	0.415
SILICON	0.13
SULPHUR	0.023
PHOSPHORUS	0.054
MANGANESE	0.73

Each sample has also been analysed for minor elements such as As, Ni, Cr, Cu, V, Ti, and Co.

The 13 per cent. Cr steel No. 211 will serve as an analytical standard for the "straight" chromium type of rustless steel, whereas the 0.3 per cent. Pb steel No. 212 is a Ledloy free-cutting steel and is useful as an analytical standard for the determination of lead in steel, where possible the methods for Pb, S, and P recommended by the Iron and Steel Institute Sub-Committee on Standard Methods of Analysis have been used. Eight or nine different chemists representing independent analysts, Government departments, manufacturers and users of these grades of steel have taken part in the analytical standardisation. Fuller details will be found in the latest list (No. 315) which is just being issued. Supplies may be obtained from any laboratory furnisher or direct from Bureau of Analysed Samples, Ltd., Markington, Harrogate, Yorks.

One hundred and fifty towns and boroughs in England and Wales have now each contributed over £1000 to the Red Cross Penny-a-Week Fund through house-to-house collections. Twenty-five have contributed over £3000, and seven over £5000.

More About War Damage

The Buildings Scheme Explained

THE War Damage (Amendment) Act, 1942, is a measure which alters the War Damage Act, 1941, in important details, and this article, as far as space allows, shows the statute as it now applies to buildings, with the amendments and new provisions included. The Buildings Scheme applies to buildings and other immovable property, including machinery and plant, and is a compulsory scheme. By former measures, cover against war damage was given from September 3, 1939, to August 31, 1942 (*i.e.*, the "risk period"), and the contribution is 10s. in the pound against the Schedule A (Income Tax) assessment, payable in instalments of 2s. poundage, due on July 1 in the years 1941-45 inclusive.

Now, by this new 1942 Act, the cover is continued indefinitely, the "risk period," when required, to be terminated by Treasury Order and, moreover, the contribution and instalments continue in the same way as just explained. The following should, however, be noted: if at any time it is estimated (estimates are made periodically) that the expected receipts will fall short of half the expected payments the number of or the rate of the instalments (or both) can be increased by Treasury Order; if, on the other hand, the receipts are estimated to exceed the payments, Parliament can decide how the receipts are to be reduced.

The Schedule Assessment (Income Tax) to apply will be that of September 3, 1939, in most cases, as increases cannot be made between general valuations (except where there are structural alterations, additions, etc.) and the "quinquennial" intended for 1941-2 has been postponed until after the war. If there is a decreased assessment the Acts provide that this, notwithstanding the alteration, shall not apply for the contribution. Note the following, however: if the assessment is reduced by reason of the demolition or destruction of buildings, not caused by war damage (*e.g.*, ordinary fire, etc.), the reduced assesment *will* apply for the instalments from 1942 onwards (not for the 1941 instalment, however).

Where a tenancy is for seven years or less, the landlord pays the contribution, but for longer leases this is payable by landlord and tenant, and is proportioned to each according to a formula based on the unexpired term, the rent and the annual value (the lower the rent the higher the tenant's proportion). By this Act it is provided that if there is a remission of rent by the landlord or if no rent is payable by reason of the Landlord and Tenant (War Damage) Acts (*e.g.*, where premises are unfit), the tenant's share is not to be increased. The foregoing can be said to safeguard the tenant; on the other hand, the following new provision safeguards the landlord; if the rent is one inclusive of rates, etc., the rent to apply for the formula is a sum with an amount deducted for the said rates, etc.

If premises are repairable, a "cost of works payment" is made; if it is not considered expedient to repair, a "value payment," but up to now both sorts of payment could be made in respect of the same property, and the payment had to be one or the other. Now, by this new Act, the War Damage Commission can make either or both payments, and this will be best understood by an example. Suppose a firm does not wish to reconstruct exactly as before the damage, say to omit a top floor, and in lieu thereof to erect another building elsewhere; the Commission can now give "cost of works" payment in respect of the part repaired, and a "value payment" for the part not repaired. If the instalment is not paid on the date due, the Inland Revenue can now call upon the landlord to pay over the rent as and when received until the amount owing is paid.

Tin Economy

Emergency Methods Outlined

THE current issue of *Tin and Its Uses* (No. 13), published by the Tin Research Institute, is devoted to emergency economies in tin, as during the present period of scarcity the Institute is offering its services in the solution of tin economy problems. It is shown that important economies can be effected in joining lead-sheathed cables both by using a solder less rich in tin and by the use of a new type of joint requiring not more than one-third the quantity of solder needed for the traditional wiped joint. A saving of the order of 99 per cent. can be effected by using a cup and cone type of joint on lead pipes instead of the usual wiped joint. The ends of the pipes are shaped to male and female cones, which are then sweated together with solder foil. A standard lead pipe joined in this way with only 0.05 oz. of solder withstood a pressure of 1130 lb./sq. in.

Another article describes the advantages of thinly coated electrolytic tinplate as a substitute for ordinary tinplate in the present emergency. An automatic plant of a type suitable for plating batches of standard sized sheets is illustrated. An article on "Bearings with less Tin" reviews the recommendations made by the Technical Advisory Committee of the Ministry of Supply. This issue also includes a discussion of the pros and cons of a war-time extension of de-tinning.

Personal Notes

SIR ALEXANDER AIKMAN has been appointed a director of the Dunlop Rubber Company, Ltd.

DR. A. J. V. UNDERWOOD has become a member of the Mechanical Engineering Advisory Committee of the Central Register.

MR. E. C. LITTLE, who has been in the services of Bell's Asbestos and Engineering, Ltd., for 55 years, has joined the company's board.

MR. HENRY J. ROSS and MR. JAMES DON have been elected directors of the United Molasses Company. Mr. Ross is a director and member of the executive committee of the Distillers Company, and Mr. Don has for many years been secretary of United Molasses.

The following appointments by the Minister of Fuel and Power fill the remaining vacancies among the Regional Coal Controllers in the eight coal-producing districts: MR. WILLIAM JONES (S. Wales), MR. T. HORNSBY (Durham), MR. F. C. TEMPLE (Northumberland and Cumberland).

SIR HENRY T. TIZARD, K.C.B., A.F.C., F.R.S., Rector of the Imperial College of Science and Technology, has been elected President of Magdalen College, Oxford, in succession to the late Dr. G. S. Gordon. Sir Henry Tizard is a member of the council of the Ministry of Aircraft Production and an additional member of the Air Council. He was permanent secretary of the D.S.I.R. in 1927-29, and has been chairman of the Aeronautical Research Council since 1933.

Obituary

CAPTAIN JOHN GRAHAM, inventor of the Graham patent single davit and the Graham impregnated type of steel, died recently in Liverpool. For some time Captain Graham was with the Dollar Company in America. He came back to this country in 1913.

STANDARDISATION OF DRUGS

The Proprietary Association of Great Britain, registered on July 23, as a company limited by guarantee (375,216), without share capital, has been founded to promote co-operation between manufacturers, distributors, or accredited agents or representatives for the distribution of proprietary medicines, proprietary foods and beverages, antiseptics, disinfectants and germicides and allied preparations manufactured or marketed in the United Kingdom; to formulate and establish schemes for regulating conduct, and for precluding the use of inaccurate or misleading practices; to collect and disseminate information; to take steps for giving publicity to the objects of the association; to cause any mark or symbol to be recognised by the public as indicating conformity to the standards of trading laid down by the association, etc. The income and property are to be applied solely towards the promotion of these objects.

The majority of the first members of the executive committee are either directors of companies manufacturing proprietary drugs, fine chemicals, disinfectants, etc., or are otherwise connected with the chemical or pharmaceutical industries. The original number of members is 200, each liable for £10 in the event of winding-up. The word "Limited" is omitted from the title of the company by licence of the Board of Trade.

Collapsible Tubes

Lead-Tin Alloys and Welded Sealing

AN interesting scheme has been launched by British makers of toothpaste, backed by a substantial allocation from their publicity funds. The recovered tin is sold to the secondary tin market and the money so obtained is handed over to the Red Cross Society.

Administrative action was taken at an early date to stop the manufacture of new collapsible tubes from pure tin; but for such purposes as toothpaste, cosmetics, ointments, etc., and for tubes containing certain medicaments for the application of which a specially shaped nozzle is required, a tin-coated, lead-tin alloy is sanctioned, absorbing only about 3 per cent. of tin by weight. The use of pure tin tubes is now restricted to a few medical preparations, such as eye ointments and preparations containing mercury salts, applications of the kind being regulated by a committee of pharmaceutical experts. As, however, factories, wholesalers and retailers usually carry substantial stocks, and as the life of these products runs into many months, it is probable that the gradual surrender of used pure tin tubes might go far to balance the consumption of tin required for the tin-coated lead tubes throughout the war period. By voluntarily returning used tubes the private individual can not only augment the Red Cross funds, but can also make a useful contribution to tin economy.

Welded Collapsible Tubes

Collapsible tubes can be sealed hermetically by a new electric welding method, developed by Mr. O. J. Bruun, of Slough. It is claimed that the difficulties of embrittlement and loss of strength hitherto associated with soldered or welded collapsible tubes have been overcome, and that a completely airtight joint results. The new tubes are being used for certain chemical defence preparations. It is believed that this development after the war will extend the use of collapsible tubes for a much wider range of products, where evaporation has been a difficulty.

General News——From Week to Week

Thirty-two new members of the Society of Chemical Industry were elected at last month's Council meeting.

In the three months ended June 30, South Crofty tin mine, in Cornwall, crushed 15,259 tons of ore, recovering 156 tons of black tin (22.9 lb. per ton crushed).

The Plastics Control of the Ministry of Supply has moved to Universal House, 56 Buckingham Palace Road, London, S.W.1. (Telephone: Sloane 9985).

The pollution of Ullswater by lead-mining effluent, previously referred to in our columns, has recently shown a marked diminution, according to Lord Zetland's statement at the annual meeting of the National Trust last Monday.

The campaign sponsored by the Ministry of Supply to collect and dry more of our native medicinal plants is now progressing well. In nearly all counties a Herb Committee has been formed to organise the work.

Fatal injuries were suffered last week by James Harrold, millworker, of Port Glasgow, when he became entangled with a revolving shaft of a filtering machine at the Oil and Cake Mills, Greenock, where he was employed.

Attention is drawn by the Ministry of Food to the provisions of the Milled Wheaten Substances (Restriction) Order, 1940, which prohibits, except under licence, the purchase, sale, or use of any milled wheaten substance for any purpose other than the manufacture or preparation of any article of food.

The importance of the chemist's part in the food industry was stressed by Mr. W. V. Griffith, B.Sc., A.I.C., in a recent address to the Dublin Rotary Club. Other speakers on the same occasion included Mr. John Irwin, managing-director, Imperial Chemicals (Ireland), Ltd.

Two forms of wastage, which are more common than is realised, have been reported by correspondents to the *Belfast News-Letter*. Housewives, it seems, have taken to using cornflour as a substitute for starch, while, owing to a shortage of matches there is a prevalent habit of leaving on gas jets which could be turned off and re-lighted later.

The use of paraffin oil for domestic purposes from September until the end of the year is likely to be permitted by the Eire Department of Supplies. A substantial reduction in the use of kerosene has been effected this year as a result of a close scrutiny of all applications for agricultural and industrial purposes. Since the end of March the distribution of kerosene for domestic purposes has been suspended.

With the exception of lime, fertilisers which do not contain nitrogen or potash, or both, are a waste of time and money for farmers, for they may cause loss of crops, says a Ministry of Agriculture notice. Iron sulphate should not be used as a manure as it does not increase crop yields and may have harmful effects.

The Ministry of Food announces that the Soap (Licensing of Manufacturers and Rationing) Order, 1942, and Amendments, have been consolidated into the new Soap (Licensing of Manufacturers and Rationing) (No. 2) Order, 1942, which provides for the various changes necessitated by the introduction of new editions of ration books and documents for the new rationing year begun July 26.

A new form of application for export licences (Application Form D) has been prepared, and should be used wherever practicable. Form B will continue to be accepted, but where it is used it may be necessary to ask for additional information. Exporters will assist the Export Licensing Department by refraining from submitting applications to export goods in short supply which are needed at home for war purposes.

To secure the most equitable distribution for production usage of ball and roller bearings and to prevent over-stocking of such bearings, the Ministry of Supply has issued the Control of Ball and Roller Bearings (No. 2) Order, 1942 (S.R. & O. 1942, No. 1397), which came into force on July 22, controlling the acquisition and stocking of bearings. This Order does not affect bearings required for repair or maintenance of any other article.

A general licence (S.R. & O., 1942, No. 1402), made by the Board of Trade, permits registered dealers in polishes to supply polishes controlled by the Limitation of Supplies (Heating Apparatus and Polishes) Order, 1942, to the N.A.A.F.I., or to certain other specified organisations named in the schedule to the licence, on production of an order for the goods which has been stamped or certified on behalf of the Secretary of State for War.

At the annual general meeting of British Plaster Board, Ltd., last week, Lord Belper, the chairman, noted that demands had been made upon them by manufacturers for various materials previously imported, but not now available, and stated that their laboratories had been successful in developing processes and producing lines to assist in the manufacture of a variety of goods now in demand. The consolidation and development of the gypsum industry had been of inestimable value to the country.

A meeting was held on Thursday at the Ministry of Fuel and Power between the Fuel Efficiency Committee of the Ministry and representatives of the Royal Ordnance factories, which are among the largest wartime consumers of fuel in the country. The whole question of fuel economy and efficiency in the use of coal, gas, electricity, and oil in the factories was discussed.

Foreign News

Kentucky University chemists, working on the problem of unmarketable grades of tobacco, have been rewarded by discoveries which show low-grade tobacco to be far from worthless, as from it can be made varnish, insecticide, fibre-board, soap, and paper bags.

The production of industrial alcohol from wheat on a big scale is starting in Australia, says Reuter, reporting a statement made at Sydney by Mr. J. Beasley, chairman of the Allied Supply Council. Four distilleries are being built with a total consumption of nearly 5,000,000 bushels of wheat, and each with a capacity of 3,000,000 gallons of alcohol.

Following the decision in Australia (after negotiations with the British Government) to increase the price of tungstic ores (wolfram and scheelite) from 60s. to 100s. sterling per unit f.o.b., it has been arranged to pay a flat rate of 90s. sterling per unit at the point of production. Action is being taken to create a pool to provide for the varying freight and other charges.

The possibility of power shortage in 1943 is worrying chemical engineers in America. They are looking for processes which do not use much electricity, even if they are not quite so efficient as the old methods. One example is in chlorine manufacture, which this year will employ electric cells, but which will, in 1943, involve a new chemical process.

Production of slab zinc in the United States in 1941, at 881,523 short tons, was the highest total ever recorded, exceeding the previous record of 1940 by 22 per cent. Both domestic and foreign ores contributed to the increase. Production from the former source advanced 11 per cent. to the largest tonnage on record, and the quantity produced from foreign ores was 63 per cent. greater than the previous record of 104,005 tons in 1916.

Striking photographs have been released of the attacks of the R.A.F. on chemical works in occupied Europe. One of the latest shows bombs bursting on a Kuhlmann factory in the outskirts of Lille. Raids are now being made also on chemical works in Holland, one this week having been reported at Sluiskil, though the actual factory is not specified. There are (or were) several chemical plants in this area, notably another Kuhlmann establishment at Selzaete, just over the border in Belgium.

Carbon black production in 1941 in the U.S.A. was 594,065,000 lb., 4 per cent. above the record established in 1940; total sales were 644,744,000 lb., 22 per cent. above the 1940 figure, and 15 per cent. above the record of 1939. The average price per lb. was 3.26 cents; prices were raised in April and there was another advance in July.

In a recent talk to the Canadian Chemical Association at Hamilton, Ontario, Mr. F. E. Lathe, of the National Research Council, Ottawa, said that experimental work had been carried out in Nova Scotia in connection with the use of phosphatic slag from steel furnaces to produce fertilisers for agricultural production.

Plans for the immediate erection of a plant that will substantially increase the supply of ammonia and its derivatives in the U.S.A. have been announced by Mathieson Alkali Works, New York. The new plant will be financed by the Defense Plant Corporation and will be erected and operated under lease by the Mathieson organisation. The ammonia will be produced synthetically by a modification of existing methods.

The U.S. Senate has voted for the creation of an independent agency to produce synthetic rubber from grain alcohol, in spite of protests by the Administration against interference with the War Production Board's control of the rubber programme. The measure has been sent to the House of Representatives, where the Rules Committee has already approved an identical measure, says Reuter.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Satisfaction

COXETER & SON, LTD., London, W., scientific instrument manufacturers. (M.S., 1/8/42.) Satisfaction, July 7, of debentures registered October 8, 1935, to the extent of £1000.

Company News

The Yorkshire Dyeware and Chemical Co., Ltd., report a profit for the year ended March 31 last of £33,377 (£24,268), and have declared a final dividend of 7½ per cent., and a bonus of 2½ per cent., making 12½ per cent. (7½ per cent.) for the year.

The directors of **Benn Brothers, Ltd.** (proprietors of THE CHEMICAL AGE), announce the following final dividends, less tax, for the year ended June 30: 3 per cent. on preference shares, making 6 per cent. for the year; 11 per cent. on ordinary shares, making 15 per cent. (12 per cent.) for the year; 3s. per share on deferred shares (2s. 4 4/5d.).

Van den Berghs and Jurgens, Ltd., report a profit for the year 1941 of £1,337,267 (£1,558,844), and have declared a dividend on the ordinary stock of 8 per cent., tax free (10 per cent., tax free).

English China Clays, Ltd., have declared a dividend of 7 per cent. on the cumulative preference shares, for the half-year ended June 30. Last year no dividend was paid for the corresponding half-year, but a dividend of 1¾ per cent. was paid for the 3 months to March 31, 1941.

New Companies Registered

Macclesfield Chemicals, Ltd. (375,086).—Private company. Capital: £200 in 200 shares of £1 each. Chemists, drysalters, druggists, chemical manufacturers and refiners, etc. Directors: N. B. Maurice and Mrs. D. Maurice (both directors of Macclesfield Dyers, Ltd.). Registered office: Pearle Street, Macclesfield, Cheshire.

Johnston, Harding & Co., Ltd. (375,238).—Private company. Capital: £2000 in 2000 shares of £1 each. General merchants, brokers, importers, exporters and agents, for the purchase and sale (wholesale and retail) of metals, metal products, chemicals and raw or manufactured textile and leather goods, etc. Subscribers: N. Rosenfelder, 68 Leeside Crescent, N.W.11.; E. L. Hackenbroch.

Merevale Engineering Co., Ltd. (375,212).—Private company. Capital: £1000 in 1000 shares of £1 each (200 "A" and 800 "B"). Manufacturers of, agents for and dealers in engineering plant, mechanical and chemical articles, electrical appliances, etc. Subscribers: L. Meredith; A. Hackett. L. Meredith is the first director. Registered office: 250 Bradford Road, Castle Bromwich, Warwickshire.

Ferros Products, Ltd. (375,234).—Private company. Capital: £1000 in 10,000 preferred ordinary shares of 1s. each and 500 ordinary shares of £1 each. Manufacturers of and dealers in Ferros Cleaner and other cleaners, disinfectants, oils, soaps, toilet requisities, metal and boot polishes, paints, varnishes, etc. Subscribers: Edith Dutton; Harriet Lynch. Registered office: 11 Dale Street, Liverpool.

Celanese Plastics Development, Ltd. (375,032).—Private company. Capital: £500,000 in 300,000 shares of £1 each. Objects: to carry on the business of manufacturers, importers, exporters, and dealers in plastics and synthetic resins, and all kinds of chemical substances and products, drugs, paints, varnishes, enamels, coatings, colours and their transformation products and derivatives; to carry out research work, etc. Subscribers: W. H. Poxon, A. R. Currie. Registered office: Celanese House, 22 Hanover Square, W.1.

Sherley's Agricultural Laboratories, Ltd. (375,171).—Private company. Capital: £100 in 100 shares of £1 each. To make research and experiments into the treatment, feeding and cure of animals and birds, and the treatment and improvement of vegetable and agricultural products, to establish laboratories, etc. Directors: Philip E. Hill; J. S. Holmes, M.P.; B. L. Hobrow; N. F. Fabricius. Registered Office: 68 Pall Mall, S.W.1.

Chemical and Allied Stocks and Shares

AS the Russian war news has continued to induce an attitude of caution in the stock and share markets, values in most sections were inclined to react. Nevertheless, on balance, movements have been small and the general undertone was steady, sentiment having been assisted by the continued absence of any heavy selling. In fact, all classes of stocks and shares remained firmly held, and in many instances were again only in small supply in the market.

Among leading industrial securities which usually reflect the general trend closely, Imperial Chemical were 32s. 10½d., compared with 33s. 1½d. a week ago, and the 7 per cent. preference units eased slightly to 34s. Lever and Unilever at 29s. 3d. showed a decline of only 3d. on balance, while at the time of writing, Turner and Newall have remained at 68s. 1½d., and Boots Drug at 36s. 3d. showed a small improvement on balance. Textile issues remained prominent, but best prices made recently were not fully held. Courtaulds were 37s. "ex" the interim dividend, and British Celanese moved back slightly to 10s. 9d., although at the time of writing the second preference shares have maintained a steady appearance around 23s. 6d. United Glass Bottle were 55s. awaiting the interim dividend, which is expected to be maintained. Triplex Glass 10s. shares were 33s. 1½d. and had a firm appearance, the market having remained hopeful that an improved dividend may be paid for the past financial year. Other shares of glass companies were steady, sentiment having tended to be assisted by the improved results reported by Splintex Safety Glass. At 24s., British Plaster Board 4s. shares have held the impovement which followed the annual meeting; it is generally realised that although the dividend for the year ended March last, was raised to 25 per cent., this was conservative, being well below the rate actually earned on the shares. Associated Cement had an easier appearance at 48s. 1½d., but elsewhere, Barry and Staines rallied to 31s. 6d. on consideration of the chairman's annual statement. Nairn and Greenwich were again

51s. 3d., and Wall Paper Manufacturers deferred units 27s. 3d. Business at 5s. 1½d. was recorded in Greeff-Chemicals.

A fair amount of attention continued to be given to shares of companies associated with plastics. British Industrial Plastics 2s. shares were 4s. 7½d. The yield on the latter is small, last year's dividend having been 6 per cent., but the tendency is to take the long view in the hope that, as time proceeds, earnings and dividends may advance owing to the growing importance of plastics. Lacrinoid Products 2s. shares were around 8s. 10½d., and Erinoid 5s. ordinary were quoted at 8s. 6d.

Imperial Smelting shares were better at 11s. 9d. Iron and steel issues were fairly steady, with Richard Thomas 6s. 6d. and United Steel 22s. 7½d., but elsewhere, Tube Investments moved back to 85s. 3d., although Dorman Long were better at 18s. 7½d. British Glues and Chemicals 4s. shares were maintained at 6s. 3d., while B. Laporte were again 66s. 3d., and firmly held. Fison Packard continued at 38s. 1½d., and British Drug Houses at 18s. 9d. General Refractories were again 11s. 1½d., and Cellon 5s. ordinary, 15s. 6d. Moreover, Borax Consolidated were steady at 31s. 3d. The units of the Distillers Co., however moved back from 78s. 3d. to 77s. 9d. United Molasses at 27s. 9d. were virtually unchanged on balance. At 65s. 6d. British Oxygen were within 3d. of the price ruling a week ago, and British Aluminium showed a small improvement to 43s. 3d. British Match were again 34s. 6d., and Amalgamated Metal 14s. 3d. Dunlop Rubber eased to 27s. 6d., and Metal Box to 75s., but the latter was "ex" the recently-declared dividend. Firmness was shown by Allied Ironfounders at 33s. Elsewhere, Sangers were 16s. 7½d., Timothy Whites 22s. 7½d., and Beechams Pills 11s. 10½d. Lower prices ruled for oil shares.

British Chemical Prices

Market Reports

ACTIVITY is pretty well sustained in most sections of the industrial chemicals market and delivery specifications under existing contracts continue to cover good volumes. Among the soda products there is a good call for hyposulphite of soda, whilst a ready outlet can be found for chlorate, yellow prussiate, and bichromate of soda. Among the potash products strong values continued to be maintained. Oxalic, tartaric and citric acids are in strong request, whilst elsewhere in this section there is a good demand for acetic and boric acids. Trade in the coal tar products has been comparatively quiet during the past week, although contract deliveries have proceeded along steady lines. Crude and crystal carbolic acid and cresylic acid are in strong request, and elsewhere solvent naphtha and xylol are quiet.

MANCHESTER.—Inquiries for a rather wide range of chemicals on the Manchester market during the past week have been fairly plentiful and a moderate weight of new business has actually been placed, though it is still the case that conditions in this respect are being to some extent adversely affected by industrial holidays in Lancashire and the West Riding of Yorkshire. However, the alkalis and many other heavy chemicals are being taken up in good quantities. The price position as a whole is firm though actual movements have been slight. Contract deliveries of most of the tar products are maintained at steady level.

GLASGOW.—Business in the Scottish heavy chemical trade still remains rather quiet for the home trade. This, no doubt, is due to the annual holidays having just ended. Export business is very restricted, prices keeping firm and unaltered generally.

Price Changes

Ammonium Sulphate.—Per ton in 6-ton lots, d/d, buyers' nearest station, in August, £9 10s.; increased charge of 1s. 6d. per month up to March, 1943.

Concentrated Fertilisers.—Per ton in 6-ton lots, d/d, buyers' nearest station, in August: I.C.I. Type "Special III," £14 9s. 6d.; Type "B," £14 1s. 3d.; Type "C," £17 19s. Increased charge of 1s. 6d. per month up to March, 1943.

Lactic Acid.—Dark, tech., 50% by vol., £40 per ton. Not less than one ton lots, ex works; barrels returnable, carriage paid. Barrels charged 25s. each, amount refunded on return of barrel in good condition.

Naphtha.—MANCHESTER: 2s. 1d. to 2s. 4d. per gal.

Potash, Caustic.—Liquid, d/d, per ton, £26, in 1 to 10 ton lots; under 1 ton, £27 10s.

Xylol.—MANCHESTER: 3s. 2d. to 3s. 3½d. per gal.

SERVICING

GRINDING of every description of chemical and other materials for the trade with improved mills.—THOS. HILL-JONES, LTD., "Invicta" Mills, Bow Common Lane, London, E. Telegrams: "Hill-Jones, Bochurch, London." Telephone: 3285 East.

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